Desktop Encyclopedia of Telecommunications

Nathan J. Muller

McGraw-Hill
New York San Francisco Washington, D.C. Auckland Bogotá
Caracas Lisbon London Madrid Mexico City Milan
Montreal New Delhi San Juan Singapore
Sydney Tokyo Toronto

Library of Congress Cataloging-in-Publication Data

Muller, Nathan J.
Desktop encyclopedia of telecommunications / Nathan J. Muller.
p. cm.
Includes index.
ISBN 0-07-044457-9
1. Telecommunication—Dictionaries. I. Title.
TK5102.M85 1998
384'.03—dc21
97-41307
CIP

McGraw-Hill
A Division of The McGraw-Hill Companies

5 6 7 8 9 0 DOC/DOC 9 0 3 2 1 0 9

ISBN 0-07-044457-9

Illustrated by Linda L. Tyke.

The sponsoring editor for this book was Steve Chapman, the editing supervisor was Stephen Moore, and the production supervisor was Pamela Pelton. It was set in Souvenir Light by Jan Fisher through the services of Barry E. Brown (Broker—Editing, Design and Production).

Printed and bound by R. R. Donnelley & Sons Company.

McGraw-Hill books are available at special quantity discounts to use as premiums and sales promotions, or for use in corporate training programs. For more information, please write to the Director of Special Sales, McGraw-Hill, 11 West 19th Street, New York, NY 10011. Or contact your local bookstore.

This book is printed on recycled, acid-free paper containing a minimum of 50% recycled, de-inked fiber.

- *X.29* defines the procedures that allow a packet mode device to control the operation of a PAD.
- *X.75* defines the gateway procedures for interconnecting X.25 PDNs, giving end hosts the appearance of a single X.25 network.

The relationships of these packet network standards are shown in Fig. P2.

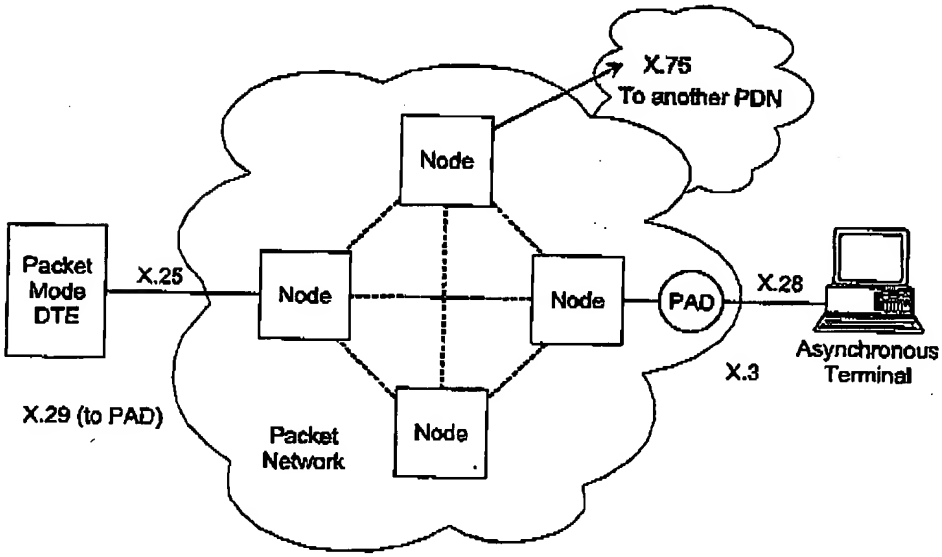

Fig. P2 *Common packet network standards.*

Summary. X.25 offers error-free communications and guaranteed delivery, making it the best choice for financial transactions and for companies that must establish international networks in countries that still have analog-based communications infrastructures in place. X.25 provides connectivity with legacy mainframes, minicomputers, and LANs. Despite the emergence of higher-speed cell- and frame-switched services that operate over more reliable digital links, such as ATM and frame relay, there is still strong demand for X.25 products and services.

See also
ASYNCHRONOUS TRANSFER MODE
FRAME RELAY

Paging

A paging system provides one- or two-way wireless messaging to give mobile users continuous accessibility to family, friends, and business colleagues while they are away from telephones. The mobile user typically carries a palm-sized device (the pager or some other portable device with a paging capability) that has a unique

identification number. The calling party inputs this number, usually through the public telephone network, to the paging system, which then signals the pager to alert the called party.

Alternatively, callback numbers and short text messages can be sent to pagers via messaging software installed on a PC, or input into forms accessed on the World Wide Web for delivery via an Internet gateway. Regardless of delivery method, the called party receives an audio or visual notification of the call, which includes a display of the phone number to call back. If the pager has an alphanumeric capability, messages can be displayed on the pager's screen.

Paging applications. There are many applications for paging. Among the most popular are:

- *Mobile messaging* allows messages to be sent to mobile workers. They can respond with confirmation or additional instructions.
- *Data dispatch* allows managers to schedule work appointments for mobile workers. Upon activating their pagers each morning, their itineraries will be waiting for them.
- *Single-key callback* allows the user to read a message and respond instantly with a predefined stored message that is selected with a single key.

Some message paging services are compatible with text messaging software programs, allowing users to send messages from their desktop or notebook computers to individuals or groups. This kind of software also keeps a log of all messaging activity. This method also offers privacy because messages do not have to go through an operator before being delivered to a recipient.

Types of paging services. There are several types of paging services available.

Selective operator-assisted voice paging. Early paging systems were nonselective and operator-assisted. Operators at a central control facility received voice input messages, which were taped as they came in. After an interval of typically 15 minutes or so, these messages were then broadcast and received by all the paging system subscribers. This meant that subscribers had to tune in at appointed times and listen to all messages broadcast to see if there were any messages for them. Not only did it waste air time, the system was inconvenient, labor-intensive, and offered no privacy.

These disadvantages were overcome with the introduction of address encoders at the central control facility and associated decoders in the pagers. Each pager was given a unique address code. Messages intended for a particular called party were input to the system, preceded by this address. In this way, only the party addressed was alerted to switch on his or her pager to retrieve messages.

With selective paging, tone-only alert paging became possible. The called party was alerted by a beep tone to call the operator or a prearranged home or office number to have the message read back.

Automatic paging. Traditionally, an operator was always needed either to send the paging signal or to play back or relay messages for the called party. With automatic paging, a telephone number is assigned to each pager and the paging terminal can automatically signal for voice input (if any) from the calling party, af-

ter which it will automatically page the called party with the address code and relay the input voice message.

Tone and numeric paging. Voice messages take up a lot of air time and, as the paging market expands, frequency overcrowding becomes a potentially serious problem. Tone-only alert paging saves on-air time usage but has the disadvantage that the alerted subscriber knows only that he or she has to call certain prearranged numbers based on the kind of alert tone received.

With the introduction of numeric display pagers in the mid-1980s, the alert tone is followed by a display of a telephone number to call back, or a coded message. This method resulted in great savings in air time usage because it was no longer necessary to add a voice message after the alert tone. This is still the most popular form of paging.

Alphanumeric paging. Alphanumeric pagers display text or numeric messages entered by the calling party or operator using a modem-equipped computer or a custom page-entry device designed to enter short text messages. Although alphanumeric pagers have captured a relatively small market thus far, this could change with the introduction of value-added services that include news, stock quotes, sports scores, traffic bulletins, and other specialized information services.

Ideographic paging. Pagers capable of displaying different ideographic language—Chinese, Japanese, and others—also are available. The particular language supported is determined by the firmware (computer program) installed in the pager and in the page-entry device. The pager is similar to that used in alphanumeric display paging.

Paging system components. The key components of a paging system include an input source, the existing wireline telephone network, the paging encoding and transmitter control equipment, and the pager itself.

Input source. A page can be entered from a phone, computer with modem or other type of desktop page-entry device, a PDA, or through an operator who takes a phone-in message and enters it on behalf of the caller. Various forms posted on the World Wide Web also can be used to input messages to pagers (Fig. P3 and Fig. P4).

Telephone network. After the message is input, the page is sent through the public switched telephone network (PSTN) to the paging terminal for encoding and transmission through the wireless paging system. Typically the encoder accepts the incoming page, checks the validity of the pager number, looks up the directory or database for the subscriber's pager address, and converts the address and message into the appropriate paging signaling protocol. The encoded paging signal is then sent to the transmitters (base stations), through the paging transmission control systems, and broadcast across the coverage area on the specified frequency.

Encoder. Encoding devices convert pager numbers into pager codes that can be transmitted. There are two ways in which encoding devices accept pager numbers, manual and automatic. In manual encoding, a paging system operator enters pager numbers and messages via a keypad connected to the encoder. In automatic encoding, a caller dials up an automatic paging terminal and uses the phone keypads to enter pager numbers. Regardless of the method used, the encoding device then generates the paging code for the numbers entered and sends the code to the paging base station for wireless transmission.

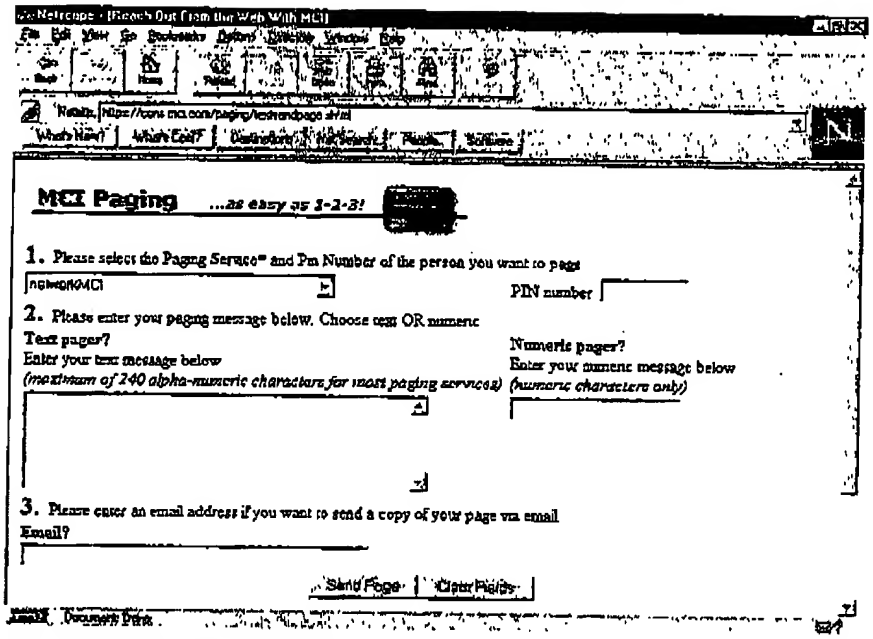

Fig. P3 *MCI offers a Web pager that lets anyone send a page to anyone who has a networkMCI or SkyTel one-way pager. All the user needs is the pager's PIN to send a 240-character message to alphanumeric pagers or 10 characters to a numeric-only pager.*

Base station transmitters. The base station transmitters send page codes on an assigned radio frequency. Most base stations are specifically designed for paging, but those designed for two-way voice can be used as well.

Pagers. Pagers are essentially FM receivers tuned to the same RF frequency as the paging base station. A decoder unit built into each pager recognizes the unique code assigned to the pager and rejects all other codes for selective alerting. Pagers can be assigned the same code for group paging, however. There also are pagers that can be assigned multiple page codes, typically up to a maximum of four, allowing the same pager to be used for a mix of individual and group paging functions.

Signaling protocols. The paging terminal in a paging system, after accepting an incoming page and validating it, will encode the pager address and message into the appropriate paging signaling protocol. The signaling protocol allows individual pagers to be uniquely identified/alerted and to be provided with the additional voice message or display message if any.

Various signaling protocols are used for the different paging service types, such as tone-only, tone and voice, etc. Most paging networks are able to support many different paging formats over a single frequency. Many paging formats are manufacturer-specific and often proprietary, but there are public-domain protocols, such

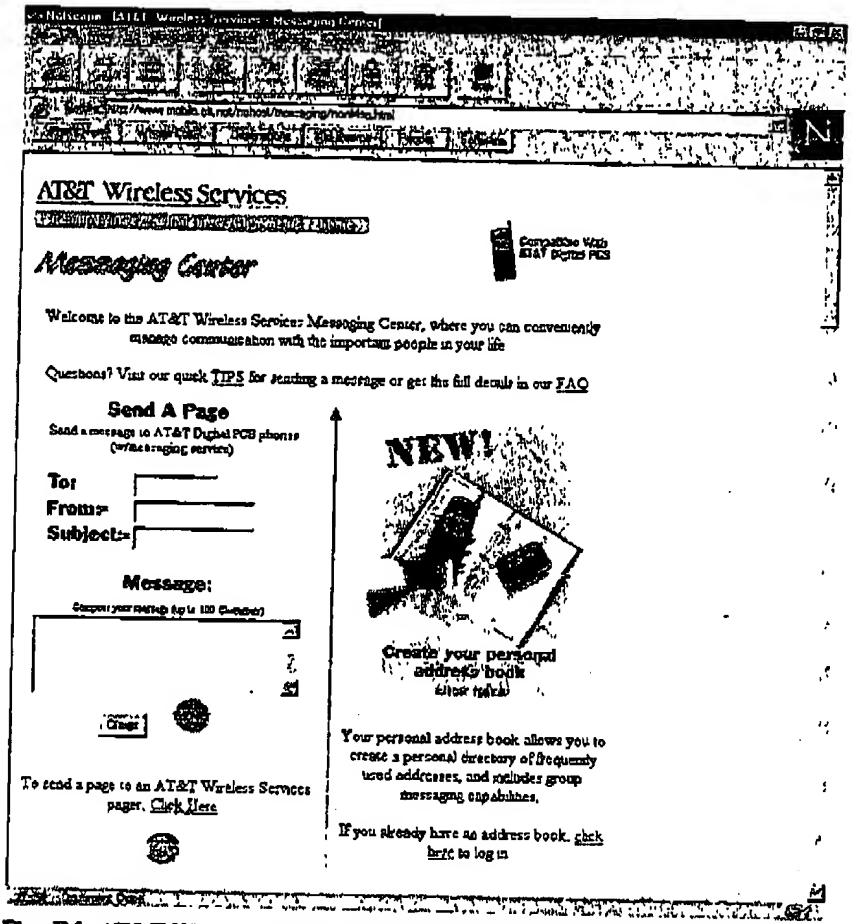

Fig. P4 *AT&T Wireless offers a Web pager that lets anyone send a message to people who carry AT&T PCS phones, alphanumeric pagers, and CDPD-compliant PocketNet phones.*

as the Post Office Code Standardization Advisory Group (POCSAG), that allow different manufacturers to produce compatible pagers.

POCSAG is a public-domain digital paging format adopted by many manufacturers around the world. It can accommodate two million codes (pagers), each capable of supporting up to four addresses for such paging functions as tone-only, tone and voice, and numeric display. POCSAG operates at data rates of up to 2400 bps. At this rate, sending a single, tone-only page requires only 13 milliseconds. This is about 100 times faster than two-tone paging.

With the explosion of wireless technology and dramatic growth in the paging industry in many markets, existing networks are becoming more and more over-

crowded. In addition, RF spectrum is not readily available because of demands by other wireless applications. In response to this problem, Motorola has developed a one-way messaging protocol called Flex (Feature-rich Long-life Environment for eXecuting), which is intended to transform and broaden paging from traditional low-end, numeric services into a range of PCS/PCN and other wireless applications.

Relative to POCSAG, Flex can transmit messages at up to 6400 bps and permit up to 600,000 numeric pagers on a single frequency, compared to POCSAG's 2400 bps transmission rate and 300,000 users per frequency. In addition, Flex provides enhanced bit error correction and much higher protection against signal fades common in FM simulcast paging systems. The combination of increased bit error correction and improved fade protection increases the probability of receiving a message intact, especially longer alphanumeric messages and data files that will be sent over PCS/PCN. Motorola has also developed ReFlex, a two-way protocol that will allow users to reply to messages, and InFlexion, a protocol that will enable high-speed voice messaging and data services at up to 112 kbps.

Summary. The computer hardware and software used in radio paging systems have also evolved from simple operator-assisted systems to terminals that are fully computerized, with such features as message handling, future delivery, user-friendly prompts to guide callers to a variety of functions, and automatic reception of messages. Paging's low cost, ease of use, and numerous practical benefits make it one of the fastest-growing communications services. Today there are more than 65 million paging subscribers worldwide, of which more than half—some 35 million—are Americans. Global demand is expected to grow by 25 to 30 percent a year during the next few years.

See also
ELECTRONIC MAIL
PERSONAL COMMUNICATION SERVICES
PERSONAL DIGITAL ASSISTANTS

Pay-per-call services

Pay-per-call services, also known as "audiotext" or "900" services, provide telephone users with a variety of recorded and interactive information programs for which they are charged rates different from, and usually higher than, the normal transmission rates for ordinary telephone calls.

In 1991 the FCC adopted regulations governing interstate pay-per-call services to address complaints from consumers of widespread abusive practices involving 900 services. Among other protective measures, the FCC:

- Required that pay-per-call programs begin with a preamble disclosing the cost of the services and affording the caller an opportunity to hang up before incurring charges.
- Required local exchange carriers (LECs), where technically feasible, to offer telephone subscribers the option of blocking access to 900 numbers.
- Prohibited common carriers from disconnecting basic telephone service for failure to pay pay-per-call charges.